simple, however, since the emitted radiation can easily be made visible by irradiating a wide spectral range.

In other embodiments described in more detail below, precisely the interaction of the two substance properties is used as the basis for evaluation in authenticity testing. The effects arising from the interaction of the two marking substances cannot be imitated in a simple way and therefore offer particularly high falsification security.

According to the invention, the luminescent marking substance emits in the infrared spectral range, preferably at a wavelength λ above about 1100 nm, particularly preferred above about 1200 nm. This has the advantage that the luminescence can then not be detected with conventional and readily available infrared detectors, which are mainly sensitive in the wavelength range from 780 to 800 nm. Conventional silicon photodiodes do not permit detection of infrared radiation with wavelengths above about 1100 nm due to the band gap of silicon of 1.12 eV. Detectors for longer-wave infrared radiation are fundamentally more elaborate and not available to everyone.

It has in particular proved expedient if the luminescent marking substance emits in the absorption range of the infrared absorbing marking substance. This permits the above-mentioned interaction effects of the two marking substances to be utilized. Excitation of the luminescent marking substance is advantageously likewise effected in the infrared spectral range, preferably in the spectral range from about 800 nm to about 1000 nm.

According to an advantageous development of the invention, the infrared absorbing marking substance is essentially colorless or has only weak inherent color in the visible spectral range. It is then invisible or appears only inconspicuously under ordinary lighting conditions. In particular, the infrared absorbing marking substance can be transparent in the visible. Even at a wavelength of about 800 nm, the infrared absorbing marking substance advantageously still has no significant absorption in order to escape detection by customary infrared detectors.

Claims

1. A value document having a machine-readable authenticity mark, characterized in that the authenticity mark comprises a luminescent marking substance emitting in the infrared spectral range, preferably at a wavelength λ of 880 nm, preferably above about 1100 nm, especially preferably above about 1200 nm, and a marking substance absorbing in the infrared spectral range.

2. The value document according to claim 1, characterized in that the luminescent marking substance emits in the absorption range of the infrared absorbing marking substance.

3. The value document according to at least one of claims 1 to 2, characterized in that the luminescent marking substance is excitable in the infrared spectral range, preferably in the spectral range from about 800 nm to about 1000 nm.

4. The value document according to at least one of claims 1 to 3, characterized in that the infrared absorbing marking substance is essentially colorless or has only weak inherent color in the visible spectral range.

5. The value document according to at least one of claims 1 to 4, characterized in that the infrared absorbing marking substance significantly absorbs in the spectral range between about 1200 nm and about 2500 nm, preferably in the spectral range from about 1500 nm to 2000 nm.

6. The value document according to at least one of claims 1 to 5, characterized in that the infrared absorbing marking substance has no significant absorption at a wavelength of about 800 nm.

7. The value document according to at least one of claims 1 to 6, characterized in that the infrared absorbing marking substance comprises a doped semiconductor material or a metal oxide.

8. The value document according to at least one of claims 1 to 7, characterized in that the infrared absorbing marking substance is present in particle form with an average particle size smaller than 50 μm.

9. The value document according to at least one of claims 1 to 8, characterized in that the luminescent marking substance is formed on the basis of a host lattice doped with a rare earth metal.

10. The value document according to at least one of claims 1 to 9, characterized in that the luminescent marking substance and the infrared absorbing marking substance are formed by substances incorporated into the value document or applied to the value document separately from each other.

11. The value document according to at least one of claims 1 to 9, characterized in that the luminescent marking substance and the infrared absorbing marking substance are incorporated into the value document or applied to the value document jointly as a mixture of substances.

12. The value document according to at least one of claims 1 to 11, characterized in that the luminescent marking substance is incorporated into the value document or applied to the value document all over.

13. The value document according to at least one of claims 1 to 12, characterized in that the value document comprises a substrate, in particular a paper substrate, into whose volume the luminescent marking substance is incorporated.

14. The value document according to at least one of claims 1 to 13, characterized in that the infrared absorbing marking substance is applied to the value document, preferably being printed on the value document.

15. The value document according to at least one of claims 1 to 14, characterized in that the arrangement of the infrared absorbing marking substance represents information, such as patterns, signs or codings, preferably a bar code.

16. The value document according to claim 15, characterized in that the information is present encrypted.

17. The value document according to at least one of claims 1 to 16, characterized in that the luminescent marking substance and the infrared absorbing marking substance are present in overlapping areas of the value document.

18. The value document according to at least one of claims 1 to 17, characterized in that the value document has a printed layer which partly or completely covers the areas of the value document provided with the infrared absorbing marking substance.

19. The value document according to claim 18, characterized in that the printed layer is opaque in the visible spectral range and is transparent or translucent in the absorption range of the infrared absorbing marking substance.

20. The value document according to claim 18 or 19, characterized in that the printed layer is opaque in the emission range of the luminescent marking substance.

21. The value document according to at least one of claims 18 to 20, characterized in that the printed layer is applied by an intaglio printing technique.

22. The value document according to at least one of claims 1 to 21, characterized in that the machine-readable authenticity mark is formed over a large area, in particular with a surface area of 100 mm^2 or more, preferably with a surface area of 400 mm^2 or more.

23. The value document according to at least one of claims 1 to 22, characterized in that the infrared absorbing marking substance and/or the luminescent marking substance is incorporated in the authenticity mark with a coverage of 30% or more, preferably about 50%.

24. A security element for securing an object having a machine-readable authenticity mark as described in at least one of claims 1 to 23.

25. The security element according to claim 24, characterized in that it is disposed detachably on a carrier layer.

26. The security element according to claim 24 or 25, characterized in that it is formed as a label, seal, transfer band, sleeve or other flat transfer element.

27. A security paper for producing security or value documents, such as bank notes, identity cards or the like, having a machine-readable authenticity mark as described in at least one of claims 1 to 23.

28. A method for checking the authenticity of a value document, security element or security paper according to at least one of claims 1 to 27, characterized by the following steps:

- irradiating the machine-readable authenticity mark with infrared radiation from the excitation range of the luminescent marking substance,
- determining the emission of the authenticity mark at a wavelength from the emission range, and
- evaluating the authenticity of the value document, security element or security paper on the basis of the determined emission.

29. The method according to claim 28, characterized in that the determination of the emission is carried out in spatially resolved fashion.

30. The method according to claim 28 or 29, characterized in that the emission of the authenticity mark is determined on two opposite sides of the value document, security element or security paper.

31. The method according to claim 30, characterized in that the authenticity evaluation is carried out on the basis of a comparison of the emission from the opposite sides.

32. A method for checking the authenticity of a value document, security element or security paper according to at least one of claims 1 to 27, characterized by the following steps:

    - irradiating the machine-readable authenticity mark with infrared radiation from the absorption range of the infrared absorbing marking substance,

    - determining the absorption of the authenticity mark at a wavelength from the irradiation range, and

    - evaluating the authenticity of the value document, security element or security paper on the basis of the determined absorption.

33. The method according to claim 32, characterized in that the absorption of the authenticity mark is determined via a measurement of the transmitted and/or remitted infrared radiation.

34. A method for checking the authenticity of a value document, security element or security paper according to at least one of claims 1 to 27, characterized by the following steps:

    - irradiating the machine-readable authenticity mark with infrared radiation from the excitation range of the luminescent marking substance,

    - determining the absorption of the authenticity mark at a wavelength from the absorption range of the infrared absorbing marking substance, and

    - evaluating the authenticity of the value document, security element or security paper on the basis of the determined absorption.

35. The method according to at least one of claims 32 to 34, characterized in that the determination of the absorption is carried out in spatially resolved fashion.

36. The method according to at least one of claims 28 to 35, characterized in that the absorption of the authenticity mark is determined additionally at a wavelength from the visible spectral range for authenticity testing.

37. The method according to at least one of claims 28 to 36, characterized in that the irradiation is carried out with a light-emitting diode or a laser diode.

38. The method according to at least one of claims 28 to 37, characterized in that the arrangement of the infrared absorbing marking substance represents information, in particular a bar code, which is read by determining the absorption or emission and used for authenticity testing.

39. The method according to claim 38, characterized in that the information comprises the denomination, the currency, the emission date, the country, the printing works or special features of the value document, security element or security paper, whereby one or more of the stated pieces of information are read and processed further in authenticity testing.

40. An apparatus for carrying out the method according to at least one of claims 28 to 31 or 36 to 39, having means for irradiating the machine-readable authenticity mark with infrared radiation from the excitation range of the luminescent marking substance, means for determining the emission of the authenticity mark at a wavelength from the emission range, and means for evaluating the authenticity of the value document, security element or security paper on the basis of the determined emission.

41. An apparatus for carrying out the method according to at least one of claims 32 to 33 or 35 to 39, having means for irradiating the machine-readable authenticity mark with infrared radiation from the absorption range of the infrared absorbing marking substance, means for determining the absorption of the authenticity mark at a wavelength from the irradiation range, and means for evaluating the authenticity of the value document, security element or security paper on the basis of the determined emission.

42. An apparatus for carrying out the method according to at least one of claims 34 to 39, having means for irradiating the machine-readable authenticity mark with infrared radiation from the excitation range of the luminescent marking substance, means for determining the absorption of the authenticity mark at a wave-

length from the absorption range of the infrared absorbing marking substance, and means for evaluating the authenticity of the value document, security element or security paper on the basis of the determined absorption.

43. The apparatus according to at least one of claims 40 to 42 in form of a money processing machine, a bank note counting machine, a bank note sorting machine, a bank note reading device for the blind or partially sighted, a bank note reading device for dealings in foreign currency, or a pocket-size bank note testing device.